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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/986,332	11/08/2001	Hiroyuki Kiyoku	Q66212	5542

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EXAMINER	
ANDERSON, MATTHEW A	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 02/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/986,332	KIYOKU ET AL.	
	Examiner	Art Unit	
	Matthew A. Anderson	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 November 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *208-239* is/are pending in the application.

4a) Of the above claim(s) *221-233* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *208-220 and 234-239* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 November 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 09/ 202,141.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 208-213, 215, 217-220, 235-236, 238-239 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka et al. (WO 97/11518) in view of Takeuchi et al. (US 5,239,188) and Ohba et al. (US 5,656,832).

The examiner has used the disclosure of US 6,377,596 B1 as a translation of the PCT publication of Tanaka et al.

Tanaka et al. discloses a method for growing a low defect monocrystalline defect monocrystalline layer over a mask. The method is described as forming light emitting diodes in col. 1 lines 15-25. In Fig. 16 and in col. 28 lines 34+ the method is described. Striped openings in a insulator mask are formed on the (0001) plane of a sapphire substrate. (in col. 19 lines 65 is suggested that such stripes be formed in the direction parallel to the (11-20) A plane of a sapphire substrate. Perpendicular stripes to the (11-20) plane are also disclose in col. 11 line 55.) A GaN buffer layer is formed in the spaces between the stripes. N-type GaN is grown from the spaces laterally until it covers the mask between them (i.e. coalesces). The growth is described as by MOVPE. The defect density obtained is disclosed in col. 32 as 10^4 to 10^5 defects per

cm^2. MOVPE is described in col. 17 and 18 in which a tri-methyl gallium is reacted with ammonia to form the GaN. The substrate is disclosed as sapphire (Al2O3) or SiC. The insulator making up the mask was disclosed in col. 5 lines 65+ and col. 6 lines 1-5 as amorphous material such as SiO2, Si3N4, PSG, SION, or Ta2O3. The relative size of the spaces is seen in Fig. 16 B to less than that of the mask layers. Multiple iterations of growth and mask layer formation are suggested in Figs. 16a-16c and 18a-18c. Further, and active layer (6) is grown on the second nitride semiconductor (5) as seen in Fig. 18C.

Tanaka et al. does not explicitly suggest a buffer layer or an off angled substrate as ways of reducing the defect density of the GaN epitaxial layer obtained.

Takeuchi et al. discloses a gallium nitride base semiconductor device. In Fig. 4A,4B,4C, and 4D is shown a epitaxial overgrowth of GaN on a Si substrate using a AlN mask layer. In Col. 3 lines 35-50, it is disclosed that the nitride semiconductor will also deposit on a thin AlN buffer layer on a sapphire substrate. In Fig. 3 is shown a n-GaN single crystal. In Fig. 4C is seen the growth of GaN from the sides of the recesses in the overlying AlN layer.

Ohba et al. discloses methods of growing nitride epitaxial layers with the use of buffer layers. Ohba et al. discloses (col. 6 lines 11-23) that growing a nitride layer on a buffer layer with the use of an inclined substrate with an angle of inclination of from 0.5 degrees to 10 degrees promotes higher quality growth and the ability to facilitate lateral crystal growth.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the disclosures of the references cited to yield a method of forming a gallium nitride semiconductor as disclosed because the use of nitride buffer layers (i.e. a nitride underlayer) on a sapphire substrate and inclined or off-angled substrates to reduce defects promote lateral growth as well as use of mask layers for epitaxial overgrowth and recombination where known in the art.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to form a nitride semiconductor as disclosed in Claims 208, 211 because the use of nitride buffer layers (i.e. a nitride underlayer) on a sapphire substrate, the use of off-angled substrates to reduce defects, and the use of mask layers for epitaxial overgrowth and recombination where known in the art to produce nitride semiconductors with reduced defect densities.

In respect to claims 208, 209, 210, 217-220, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use multiple iterations of mask layers, position the second mask over the windows in the first mask, and to grow the first and second nitride semiconductors laterally on the growth masks to eventually recombine because Tanaka et al. suggests this in Figs . 16 and 18.

In respect to claim 212, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow light emitting diodes by this method because Tanaka et al. suggests this very use in col. 1 lines 15-25.

In respect to claim 213, it would have been obvious to one of ordinary skill in the art at the time of the present invention to include indium in the nitride semiconductor being grown because Tanaka et al. suggests this in col. 23 lines 35-50.

In respect to claim 215, it would have been obvious to one of ordinary skill in the art to dope the first nitride semiconductor with an n-type impurity because such a doping was known in the art (Takeuchi et al.).

In respect to claims 235, 238, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use a C-plane (i.e. that plane perpendicular to the (0001) direction) of a sapphire substrate because Ohba et al. discloses the C-plane of an off-angled sapphire substrate as useful for improving GaN epitaxial quality. (col. 6 lines 11-23)

In respect to claims 236,239, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use a C-plane (i.e. that plane perpendicular to the (0001) direction) of a sapphire substrate with an off angle equal to or less than 1 degree because Ohba et al. discloses the off-set angle of the C-plane sapphire substrate as from 0.5 to 10 degrees. 0.5 degrees (less than 1 degree) is explicitly suggested.

3. Claims 214, 216 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka in view of in view of Takeuchi et al. and Ohba et al., and further in view of Tischler et al.(US 5,679,152).

Tanaka combined is disclosed above.

Tanaka combined does not explicitly suggest using a superlattice buffer layer on the nitride substrate formed or Si doping to form n-type nitrides.

Tischler et al. discloses in column 4 lines 35-50 an alternately layered nitride superlattice to reduce the dislocation defects in a GaN crystals and alloys thereof. N-type GaN is disclosed as formed from Si additions in col. 8 lines 60+.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the superlattice of Tischler et al. with Tanaka combined because then one of ordinary skill would have expected the product crystal to have fewer defects.

In respect to claim 214, it would have been obvious to one of ordinary skill in the art at the time of the present invention to form a buffer layer as claimed because such would have been expected to improve the nitride semiconductor grown thereon.

In respect to claim 216, it would have been obvious to one of ordinary skill in the art at the time of the present invention to form n-type nitrides with Si doping because such was known in the art (i.e. by Tischler et al.).

4. Claims 234, 237 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka in view of in view of Takeuchi et al. and Ohba et al., and further in view of Harunori et al.(JP-07-201745).

Tanaka combined is disclosed above.

Tanaka combined does not explicitly that the off-angled substrate be formed stepwise.

Harunori et al. discloses (see abstract) using a stepwise formation of a (0001) a.k.a. the C plane as a growth surface for GaN epitaxy.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to use a step wise off-angled substrate because such were known in the art to improve purity and crystallinity in epitaxy methods.

In respect to claim claims 234,237, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use an off-angled substrate formed in a step pattern because such a pattern was known by Harunori et al;. to improve purity and crystallinity for GaN epitaxy on sapphire substrates.

Response to Arguments

5. Applicant's arguments filed 9/16/2004 and 11/05/2005 have been fully considered but they are not persuasive.

6. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Additionally, Ohba discloses the off-angled substrate of sapphire on which a AlN buffer layer is grown before growth of GaN occurs thereon. Sapphire (i.e. Al2O3) is dissimilar when compared to AlN or GaN.

7. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies

(i.e., a 0.2' off –angle) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Claims 208, 217 do not specify any specific off-angle. Claims 236 and 239 are at least suggested by the 0.5' to 10' off-angle taught by Ohba et al. in col. 6 lines 10-25.

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (571) 272-1459. The examiner can normally be reached on M-F, 8:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MAA
January 21, 2005

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER